ULTRASONIC TRANSDUCER, ULTRASONIC PROBE, AND ULTRASOUND IMAGE DIAGNOSIS APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of Korean Patent Application No. 10-2012-0042179, filed on Apr. 23, 2012, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

1. Field

One or more embodiments relate to an ultrasonic transducer, an ultrasonic probe, and an ultrasound image diagnosis apparatus, and more particularly, to an ultrasonic transducer having an improved electrode connection structure, an ultrasonic probe, and an ultrasound image diagnosis apparatus.

2. Description of the Related Art

An ultrasound image diagnosis apparatus is an apparatus that radiates an ultrasonic wave signal to a desired inner site of a body via a body surface of a subject and uses information about a reflected ultrasonic wave signal (ultrasonic wave echo signal) to obtain an image about a fault of soft tissues or blood flow in a noninvasive manner. Compared to other image diagnosis apparatuses, such as an X-ray diagnosis apparatus, a computerized tomography (CT) scanner, a magnetic resonance image (MRI) apparatus, or a nuclear medicine diagnosis apparatus, the ultrasound image diagnosis apparatus is small and inexpensive, displays an image in real time, and has high stability due to no radiation of, for example, X-rays. Due to these advantages, the ultrasound image diagnosis apparatus is widely used for heart, abdomen, urinary system, and obstetrics diagnoses.

The ultrasound image diagnosis apparatus may include, for example, an ultrasonic probe that transmits an ultrasonic wave signal to a subject and receives an ultrasonic wave echo signal reflected from the subject to obtain an ultrasonic image of the subject. The ultrasonic probe may include, for example a transducer, a case having an open top end, and a cover that is coupled to the top end of the case and directly contacts a surface of a subject. In this regard, the transducer may include, for example, a piezoelectric layer that includes a piezoelectric material for reversibly converting an electric signal and an acoustic signal during vibration, an acoustic matching layer that may reduce an acoustic impedance difference between the piezoelectric layer and the subject so as to allow an ultrasonic wave produced by the piezoelectric layer to be transmitted to the subject as much as possible, an acoustic lens layer that may allow an ultrasonic wave progressing forward from the piezoelectric layer to be focused on a particular point, and a sound wave absorption layer that may prevent an ultrasonic wave from progressing backward from the piezoelectric layer to prevent image distortion. In the piezoelectric layer of the transducer, a plurality of piezoelectric elements to which electrical signals are independently applied may be arranged. Electrical wiring lines with respect to the piezoelectric elements may be factors in determining the characteristics, shape, manufacturing process, and costs of the transducer.

SUMMARY

Additional aspects and/or advantages will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the invention.

One or more embodiments may provide an ultrasonic transducer having an improved electrode connection structure for electrical connection of a piezoelectric layer, an ultrasonic probe, and an ultrasound image diagnosis apparatus.

According to an aspect of one or more embodiments, there may be provided an ultrasonic transducer which may include: a plurality of piezoelectric elements arranged in at least one column; individual electrodes provided on at least one surface of top and bottom surfaces of each of the piezoelectric elements; side electrodes extending toward one side surfaces of the piezoelectric elements from the individual electrodes; and/or a side electrode substrate including wiring lines that are bonded to the one side surfaces of the piezoelectric elements and are electrically connected to the side electrodes, respectively.

The side electrodes of the piezoelectric elements located in one column may have different heights.

The heights of the side electrodes of the piezoelectric elements located in one column may be gradually decreased or increased in a lengthwise direction of the column.

The wiring lines of the side electrode substrate may include, for example, first parts respectively facing the side electrodes, second parts extending toward one side ends of the side electrode substrate, and third parts exposed by the one side ends of the side electrode substrate.

A substrate body of the side electrode substrate may be formed of an anisotropic electroconductive material having an electroconductive property in a thickness direction and having an insulating property in a surface direction, and the wiring lines of the side electrode substrate may be provided in a surface opposite to the surface where the substrate meets the side electrodes of the piezoelectric elements.

The substrate body of the side electrode substrate may be formed of an electric insulating material, and the wiring lines of the side electrode substrate may be provided in the surface where the substrate meets the side electrodes.

The piezoelectric elements may be arranged in a two-dimensional array to be spaced apart from one another in columns and lines, and a plurality of the side electrode substrates may be inserted into gaps between the columns of the piezoelectric elements.

Heights of the side electrodes of the piezoelectric elements of a first column may be gradually decreased in a lengthwise direction of the column, and heights of side electrodes of the piezoelectric elements of a second column adjacent to the first column may be gradually increased in the lengthwise direction of the column.

The wiring lines of the side electrode substrates may include, for example, first parts respectively facing the side electrodes, second parts extending toward side ends of the side electrode substrates, and third parts exposed by the side ends of the side electrode substrates, and the side ends by which the third parts are exposed of a first side electrode substrate bonded to the piezoelectric elements of the first column may be opposite to the side ends by which the third parts are exposed of a second side electrode substrate bonded to the piezoelectric elements of the second column.

The ultrasonic transducer may further include a first connection substrate electrically connected to the exposed third parts of the first side electrode substrate and a second connection substrate electrically connected to the exposed third parts of the second side electrode substrate.

Heights of the side electrodes of the piezoelectric elements of all columns may be gradually decreased or increased in the same direction.

The wiring lines of the side electrode substrates may include, for example, first parts respectively facing the side